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STRATEGIC PLAN FOR THE DEVELOPMENT OF INFORMATION SYSTEMS IN THE SOUTHWEST REGION OF NMFS

by

Roger P. Hewitt

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OF INFORMATION SYSTEMS IN THE
SOUTHWEST REGION OF NMFS

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
INTRODUCTION	4
MISSION AND ORGANIZATION OF THE SOUTHWEST REGION	5
Mission	5
Organization	6
Summary	7
ENTERPRISE ANALYSIS	8
Time Share Systems	8
Small Computer Systems	9
Operations, Requirements and Solutions	12
Summary	20
REQUIREMENTS STATEMENT	24
Planning Assumptions	24
Requirements and Options	32
SPECIFIC RECOMMENDATIONS	27
Appendix A: VAX Cost Comparisons	38
Appendix B: Annotated Bibliography of ADP Requirement Studies, Initiatives and Reviews	40
Appendix C: Functional Requirements for La Jolla LAN	44
Appendix D: Major Data Base Systems	45

EXECUTIVE SUMMARY

In this report, I review the operations of the National Marine Fisheries Service in the southwest and Pacific island region of the United States with reference to the appropriate information systems required to support them.

A region-wide integrated information system is not warranted. Laboratories and offices are dispersed over a large geographic area and dependent on each other for information distilled from raw data. However, within each laboratory and office there is a requirement for shared access to word processing, administrative information systems, data archives, scientific computers and communications equipment. Current requirements for information exchange between facilities can be met with existing telephone lines and high-speed modems.

Throughout the region there is a trend toward increased use of small computers to perform tasks previously done on larger computers. CP/M and MS-DOS computers are used to support administrative information systems, word processing, graphics production, statistical analyses, and management of small data bases. 32-bit computers have been introduced for statistical analyses, numerical modeling and data management. Although small computers are being used more than ever before, data management and analyses on time share computing facilities continue to absorb a large portion of the money associated with computer support.

The increased use of small computer systems throughout the southwest regional area is in general accordance with published plans. It is also a reflection of more general trends, in both the private and public sectors, away from centralized batch processing to distributed interactive processing, and away from large investments in singular solutions to more numerous smaller investments in integrated systems. The advantages are processor efficiency, flexibility, and the ability to incorporate more readily advances in the performance/price ratios of small computers.

I recommend that a suite of computational tools be established in each laboratory/office to meet requirements in the areas of office automation, scientific computing and data management. These tools should be electronically connected (networked) and accessible from several locations. MS-DOS computers are preferred for word processing, administrative information systems, analyses and management of small data sets. Scientific computing should be done on 32-bit computers, augmented by the facilities of the San Diego Supercomputer Center. A national initiative to provide data management capabilities to all of the regions is expected to be in place at the end of 1989; in the meantime, data management may be supported by in-house 32-bit computers, time share contract, or a combination of both. Support services should provide communication links and technical advice.

A strategy of step-wise development of information systems will best serve the southwest regional area for the next several years. This strategy recognizes computer-industry trends toward improved connectivity, adoption of network protocols, use of consistent human/machine interfaces, and shorter product life cycles. This strategy dictates multiple processors linked by networks; it allows a phased replacement of equipment; and it facilitates the capture of state-of-the-art technology where appropriate.

Specific recommendations for immediate action include:

- o Fill the Regional Data Base Administrator position (currently vacant), develop a tactical plan, obtain funding, and secure authority to proceed;
- o Install a local area network at the La Jolla Laboratory;
- o Move word processing and administrative information systems to MS-DOS computers;
- o Procure 32-bit computers to support scientific computing;
- o Use 32-bit computers, time-share contracts, or a combination of both to meet data management needs;
- o Redefine and emphasize ADP mission and organization at the La Jolla Laboratory.

INTRODUCTION

The following plan was written in response to several concerns expressed in "A Management Review of Automated Data Processing in the Southwestern U.S.," dated February 1986. The review critiqued all data processing and related activities undertaken by the National Marine Fisheries Service (NMFS) to support fishery research and fishery management in the southwestern and Pacific U.S. The review concluded that the current decentralized style of ADP operations was appropriate; however, the lack of a central focus for ADP planning and administration was considered a deficiency. The review's primary recommendation was the preparation of an "ADP Operations Plan."

Subsequently, the Director of the Southwest Fisheries Center assigned me to the task of developing such a plan. He expressed the need for a strategic statement of where we are and where we should be going; he felt that tactical plans and schedules to implement the strategic plan should logically follow.

Included in this document is a description of operations of the Southwest Fisheries Center (SWFC) and Southwest Region (SWR) of the NMFS, how information is used in these activities, and the best allocation of information resources to improve the effectiveness of the SWFC and the SWR. As such, this document establishes strategic guidelines for the development of information systems. I did not quantify workloads nor compare the cost effectiveness of various solutions. I did attempt to define the information requirements of the SWFC and the SWR region in terms of their objectives, their methods of achieving those objectives, and the current state of technology.

The sections that follow include descriptions of:

- o The mission and organization of NMFS in the southwestern U.S.;
- o The operations of each organizational unit and the appropriate information systems to support them;
- o The current distribution of hardware and a description of existing tactical solutions;
- o Planning assumptions, requirements and options; and
- o Recommendations for immediate action.

MISSION AND ORGANIZATION OF THE SOUTHWEST REGION

This section contains a brief description of the mission and organization of NMFS activities in the southwest regional area. The collection of data, its review and analysis, and finally the generation and use of information is accomplished by several groups throughout the regional area. The following is provided so that the interpretation of data and the flow of information may be seen in perspective.

Mission

The existence of two organizational units in the southwest (SWFC and SWR) is a reflection of the division of functions throughout NMFS: the fisheries centers provide information and options regarding the management of living marine resources; the regional offices monitor fisheries and administer management plans. Their work is coordinated at the national level by NMFS in Washington, D.C. and interfaces at the local level with the regional fisheries management councils, which are composed of interested citizens.

The Director of the SWFC has established the following priority order for research activities at the laboratories under his direction:

1. Generation of information and options regarding the establishment of fishery management plans, modification of the plans and their administration, as mandated by the Fishery Conservation and Management Act.
2. Generation of information and options supporting NMFS responsibilities mandated by the Marine Mammal Protection Act and the Endangered Species Act.
3. Generation of information supporting the obligations of the United States to the Inter-American Tropical Tuna Commission (IATTC), and other international tuna-related organizations.
4. Investigations of improved methodologies, new technologies, and enhanced communication of results in the broad arena of resource management science.

The Director of the SWR has established the following priorities for the offices under his direction:

1. Manage coastal fish populations as mandated by the Fishery Conservation and Management Act.
2. Manage animal populations protected by the Marine Mammal Protection Act and the Endangered Species Act.
3. Monitor exploitation of high seas fish populations and recommend international management action where appropriate.
4. Administer information and assistance programs designed to encourage fishery development.

Organization

The SWFC is organized into six divisions/laboratories and three support groups:

Divisions/Laboratories

Coastal Fisheries Resources Division, located in La Jolla, measures the recruitment and abundance of exploited fish populations, determines their optimum yield and economic value, and produces options for allocating the harvest (approximately 35 people).

Pelagic Fishery Resources Division, located in La Jolla, monitors the exploitation of tuna and billfish populations, and provides advice to the councils and commissions responsible for management (approximately 15 people).

Fishery/Marine Mammal Interactions Division, located in La Jolla, determines the effects of human activities on marine mammal populations and recommends actions to control these activities (approximately 15 people).

Honolulu Laboratory generates advice and management options regarding fish, crustacea and marine mammal populations endemic to the western Pacific (approximately 50 people).

Tiburon Laboratory generates management options to control the harvest of west coast groundfish populations (approximately 30 people).

Pacific Fisheries Environmental Group, located in Monterey, investigates population responses to variability in the physical environment; they provide information and advice to a variety of research and regulatory entities (approximately 10 people).

Support Groups

Administrative Services, under the Executive Officer, provides financial control and personnel services to all elements of the SWFC, and procurement, travel, timekeeping and building maintenance services to the La Jolla laboratory (approximately 10 people).

Scientific Reference and Editorial Services, under the Deputy Director, provides word processing, editing, illustrating and library services to the La Jolla laboratory (approximately 7 people).

Automated Data Services (also known as ADP), under the Regional Data Management Administrator, provides technical service and advice on data processing and telecommunications systems to the La Jolla laboratory and the SWR (approximately 5 people).

The SWR is organized into four offices:

Terminal Island Office, where the regional director and his staff are located, conducts management, fishery development and enforcement activities (approximately 50 people).

San Diego Office trains and deploys observers on the U.S. tropical tuna fleet (6 people plus observers).

Santa Rosa Office conducts both management and enforcement activities. Enforcement agents are also located in Eureka, Monterey, and Honolulu (approximately 10 people).

Western Pacific Program Office, located in Honolulu, conducts fishery development and management activities in the western Pacific (approximately 7 people).

Summary

The NMFS has broad congressionally-mandated responsibilities for the managed harvest, conservation and protection of marine populations and their habitats. These responsibilities are met with a dual organizational structure: the research centers provide information, advice and options to the regional offices and management councils, which in turn promulgate management plans, monitor population levels and harvest rates, and issue regulatory actions where necessary.

In the southwest, the research laboratories and regional offices are dispersed geographically. In addition, the responsibility for achieving specific national objectives is often distributed over several organizational units. The efficiency of the region is thus dependent on the timely transfer of accurate information. This requires:

1. Efficient data management and analysis tools for the research staff and,
2. Efficient document preparation, transfer and archiving tools for research, management and support staffs.

Information extracted from raw data, not the data itself, is most often exchanged between the laboratories and regional offices within the southwestern regional area. The implication is that those closest to the data are the best equipped to interpret them and that managers require information and advice, not simple numbers. This fact permits us to consider the unique needs and circumstances of each organizational entity, rather than specifying a single integrated information system for the entire regional area. Information and data exchange between regional areas is being considered at the national level; the current state of these plans is described in the section on planning assumptions.

ENTERPRISE ANALYSIS

This section contains an analysis of the region's operations and a description of the appropriate information systems to support them. Also included is a description of the computer systems currently in use.

Outlined below are:

- o Time share facilities to which the region subscribes;
- o Small computer systems in use;
- o Operations, requirements and solutions arranged by the organizational structure; and a
- o Summary listing the region's functional requirements for computer support and the solutions currently in place.

Time Share Systems

Aside from personnel costs, over half of the money associated with ADP activities is used to procure time on outside computer facilities.¹ Although this is a large share, it has steadily decreased from over 90% in 1979. The time share systems are used for management of large data bases and analyses of data sets drawn from them.² A brief description of our use of these systems follows:

University of California at San Diego

The University of California at San Diego (UCSD) has extensive computing facilities available to all the laboratories and offices of the southwest region. Access to the system is through the UCSD local area network (LAN) either by direct connection (28 ports are located in the La Jolla laboratory) or by modem. Once connected to the LAN, the user may select any one of several DEC VAX 11/780's and 11/785's, a Cray X/MP supercomputer or an SDS-40 mini-supercomputer. Use of these facilities by region personnel is for data management and, to a lesser extent, data analyses and numerical modeling.

The Southwest Fisheries Center is also a member of the consortium formed to establish the NSF-funded San Diego Supercomputer Center and to provide policy guidance to GA Technologies who operate the facility. In return for our participation, we enjoy an institutional grant of 200 service units per year "for start-up research and educational/training purposes." Allocation of this time is at our discretion. It may be used for data management activities insofar as those data are used to support research inquiries, allocated to collaborative investigators outside the lab, used for developing simulations and numerical models, or used for exploring the feasibility of a potential problem solving technique or solution. In addition, individual researchers may apply either to NSF or directly to the supercomputer center for grants of time to support

1. Financial data are taken from the annual "A-11 Report" to the Department of Commerce, which summarizes ADP expenses for the southwest regional area, including time share costs, hardware and software acquisitions, personnel, supplies, communications and contract services. These costs are summarized across organizational budgets.
2. Throughout this document I use relative terms to describe the size and complexity of data bases. See Appendix D for a list of data bases and their size by organizational unit.

specific projects. Access to world-wide government and academic networks is available through the supercomputer center.

Fleet Numerical Oceanographic Center

The Navy's Fleet Numerical Oceanographic Center (FNOC) in Monterey uses a CDC Cyber 855/860 to manage a large data base of oceanographic and meteorological observations. The Pacific Fisheries Environmental Group is located at FNOC and uses several direct ports to the Cyber to extract data sets.

University of Hawaii

The Honolulu Laboratory accesses an IBM 3081 operated by the University of Hawaii Computing Center. The computer is used for data file management and analyses of large data sets. Access to the San Diego Supercomputer Center is also available through the computing center via a DEC VAX.

NOAA Time Share Contract

The Southwest Regional Offices use the NOAA time share contract computer, currently a DEC-20 operated by EDS, to access and/or maintain several data bases, some national and some regional. Although the data bases are relatively small, frequent access causes the time share costs to be high. The region intends to move the regional data bases to small computers located in their offices. Access to national systems containing information on financial services, enforcement, MBO tracking and Saltonstall-Kennedy funds will still be required, however.

Northwest and Alaska Fisheries Center

To retrieve fish marketing information for subsequent publication, the regional office in Terminal Island accesses the Northwest and Alaska Fisheries Center's Burroughs 7800 computer. This computer is also used to manage a data base of west coast fish landings (FIN). Coastal states forward fish receipts to the data manager on a weekly basis for editing and posting to this large data base.

Small Computer Systems

Small computers are being used throughout the region to perform a variety of tasks. Before the current distribution of these machines can be discussed, a brief review of small computer architectures is necessary to define terms and to provide a context for evaluating their utility. Small computer systems in use in the region can be grouped into three categories: CP/M computers, MS-DOS computers and 32-bit computers.

CP/M Computers

CP/M computers are referred to by the name of the operating system (Control Program for Micro-computers) used to address the instruction set built into the micro processing chip (a Z80 or Z80A chip made by Zilog, or a 8080 chip from Intel). In the mid-1970's, although other micro computer architectures existed, CP/M computers became a commercial success because of their

relatively low cost and the availability of office automation software (e.g. Wordstar). However, standard implementations of the design were nonexistent; machines were marketed with a variety of proprietary disk controllers and internal architectures making it difficult for users to transfer files via disk and to connect peripheral devices.

In response to market confusion, the La Jolla Standard CP/M computer was developed at the La Jolla Laboratory using high capacity disk drives and the S-100 bus architecture. Because the Z80 chip is limited in speed and capability, the machine was designed to be upgraded to use more powerful micro processing chips as software became available. The software eventually became available -- many more programs, vastly more functional and easier to use than those written for CP/M computers. Many of these programs, however, were tightly linked to a specific hardware architecture. Although the La Jolla Standards could be upgraded to run the new programs, a substantial investment was required to develop systems software to accommodate them. Concurrently the cost of micro computers fell below the cost of assembling a La Jolla Standard and they became obsolete. The La Jolla Standard was an excellent idea designed to provide stability in a chaotic market; it served its purpose and was eventually eclipsed by the maturing small computer market. Of the 30 La Jolla Standards built, half are still in service and their use is decreasing.

The Molecular computers are also CP/M machines. Each Molecular installation consists of several CP/M computers linked to a central disk drive, modem(s), and printer(s). The computers are actually individual circuit boards mounted collectively in a single box next to the disk drive; remote terminals are connected to the computer boards, and an extension of the CP/M operating system provides access to the peripheral devices. This type of design is sometimes referred to as a "network in a box." Like the La Jolla Standards, the Molecular micro-processors can also be upgraded to run newer software but only after making a substantial investment in developing custom operating system routines.

The introduction of CP/M computers into the SWFC provided increased efficiencies and accuracy in the production of documents and fiscal control. CP/M computers were bought after a proposal to procure a larger computer system, which would have satisfied a greater range of the center's computational needs, was rejected (see Appendix B). The most dramatic impact of the CP/M computers was in the area of word processing: work habits changed as first draft composition and typing were accomplished simultaneously by the author, eliminating mistakes in interpretation by the manuscript typist and generally expediting the writing process. CP/M computers are also used for administrative tasks such as financial reporting, inventory management and mailing list maintenance.

Although CP/M computers have enhanced productivity in the southwest regional area, they have three serious limitations. First, the displays are character-based; that is, they present information only as letters, numbers and a limited set of special characters; as such they do not afford graphical abstractions of information. Second, the micro processor can only address a relatively small amount of active memory, further limiting the utility of the software. And third, largely as a result of the first two limitations, hardware and software development on CP/M computers has essentially stopped.

MS-DOS Computers

MS-DOS computers are also referred to by the name of the operating system used to address the instruction set built into the micro processing chip (originally an Intel 8088 or 8086). This architecture, introduced by IBM, was very successful and accelerated the development of the small computer market. IBM's design was widely accepted, software development rapidly expanded, and an industry was spawned to replicate the IBM hardware design. Their products became known as "clones." The micro processors were able to manipulate numbers represented by 16 bits of binary information (as opposed to the 8 bit capability of the Z80), although the data bus used to transmit information between internal components was only 8 bits wide and thus a limiting factor to operational speed. The next generation of MS-DOS computers, the IBM AT, was designed around the Intel 80286 micro processor and used a 16-bit data bus which yielded a 2- to 10-fold speed advantage (depending on the kind of operation) over the 8088 designs.

The increased speed made graphic program interfaces practical and current software developers are tending to abandon the simple character displays for more information-rich graphic displays. A new version of the MS-DOS operating system, specifically designed for the 80286 micro processor, will be available later this year; the new MS-DOS is expected to expand the utility of these machines significantly. An 80286-based computer with a high-resolution graphic display represents the current evolutionary state of MS-DOS computers.

The MS-DOS computer offers several advantages over the CP/M computer. Both the conventional character display and the more versatile graphic displays are available. Among other things, this capability allows us to see numbers arrayed on a graph, view equations and pictures as they are inserted into documents, and visualize the relationships between the pieces of a complex project. The operating system is capable of addressing 10 times that of the CP/M operating system and another order of magnitude increase has been announced for the next version. The larger address space has encouraged the development of software with much greater utility than that developed for CP/M computers. Examples include word processors with elaborate features built-in such as spell checking, thesaurus, outlining, footnoting, indexing and generating table-of-contents, full-featured statistical analysis packages that duplicate the functions of those programs previously available only on large computers, and a variety of instantly available personal productivity tools such as electronic note pads, telephone lists, and appointment calendars. Finally, MS-DOS computers and software are in a continual state of evolution and it is possible to upgrade machinery without losing the use of existing programs. MS-DOS computers are not without limitations, however. These limitations are primarily speed of operation, rather than capability; for instance, an analysis that would require several minutes on the UCSD VAX might require several hours on an MS-DOS computer.

32-bit Computers

32-bit computers are referred to by the information content of the numbers that they can manipulate in one cycle. These computers are designed around a variety of micro processor chips (Intel 80386, Motorola 68000 and 68020, and proprietary chips from DEC) and use a variety of operating systems, usually some form of UNIX with provisions for virtual memory management. The operational implication of virtual memory management is that large programs can be run, drawing on large data sets, without the requirement that they be in active memory. These machines are ideal for both scientific computing and data management; many of them also run MS-DOS programs. ,

The primary time share system used by the La Jolla Laboratory for management and analyses of large data bases is a VAX 11/780 operated by the UCSD computing center; this is a 32-bit computer as well. The MicroVAX II, also manufactured by DEC, is functionally equivalent to the VAX 11/780 and has replaced the 700 series of VAX computers. A MicroVAX II may be procured for less than the annual time share charges for use of the VAX 11/780 at UCSD (see Appendix A).

Other 32-bit computers are equally capable. A single 32-bit computer services the needs of the entire staff at the Pacific Fisheries Environmental Group; most of their work involves analyses and graphical display of large data sets drawn from the Navy's data archives. Thus, it is possible to procure small computers that approach the capacity, speed, and capability currently available to most of the staff only on time share systems.

In addition to multi-user systems, 32-bit computers are also available as single-user personal computers. Graphic workstations (a common reference to this class of small computers) are defined as having high-resolution graphic displays, built-in communication interfaces, and a 32-bit micro processor. These machines offer great potential for graphical data analysis, numerical modeling, and image analysis. Currently, they are being aggressively marketed to scientific and engineering customers by DEC, Apple, Apollo, Sun, Silicon Graphics and several smaller companies. As the competition drives the performance/price ratio higher, graphic workstations will become increasingly attractive to researchers in the southwest regional area.

Operations, Requirements and Solutions

Coastal Fisheries Resources Division

The Coastal Fisheries Resources Division conducts research targeted at improved understanding of the recruitment, growth, and harvest of coastal fish populations. Major research areas include 1) larval fish ecology, 2) fishery-oceanography interactions, 3) ichthyoplankton taxonomy, 4) survey methodology, 5) habitat evaluation, 6) econometric analyses of fisheries and their regulation, and 7) stock management options.

The Division maintains and uses a moderate size, but complex, data system, which archives biological specimens and oceanographic observations of the California Current region; most of the personnel of the Coastal Division require access to this data base. Access to a large data base of commercial

fish catches is required for economic studies. Simulation modeling and data analyses activities require access to interactive computers by several groups within the division. Word processing, spreadsheet analysis and ad hoc data management are also required throughout the Division.

The Division is dependent on the UCSD VAX for the maintenance and use of the California Current data bases and for access to the commercial catch data base. Division personnel also use the VAX for scientific computing, although much of this work has migrated to 15 MS-DOS computers distributed among 6 groups within the Division. Recently some scientific computing has been accomplished using the Cray supercomputer. Six ports to the Molecular computer are used to support word processing and posting financial data; one of these ports is further split into three. Several dedicated small computers are used to support instrumentation, and 9 CP/M computers, including 6 La Jolla Standards, are used infrequently. One upgraded La Jolla Standard is used for scientific computing. Several makeshift patch panels exist throughout the Division to facilitate the sharing of peripheral devices and ports to the UCSD LAN and the Molecular computer.

The trend within the Division is toward increased use of MS-DOS computers for most requirements, although a substantial amount of VAX computer time is still required to handle large amounts of data.

Pelagic Fisheries Resources Division

The Pelagic Fisheries Resources Division monitors and evaluates high seas tuna and billfish fisheries. The Division's activities are numerically oriented and dependent on access to four large data bases: tuna catch data, porpoise/tuna (observer) data, the porpoise survey (research) data, and the porpoise life history data. The last three data bases are used to support activities of the Fishery-Marine Mammal Interaction Division and the Senior Scientist for marine mammals. In addition, numerous smaller data bases are maintained for investigators in both Divisions. The data bases are maintained by the Division's data group, and extractions from them are made for researchers and managers on request. In practice, a research group will design and develop a data base; once the design is fixed and the data base established, the responsibility for its maintenance is transferred to the data group. Incoming data are key-entered under contract and imported via magnetic tape or floppy disk; this arrangement is satisfactory for current and future requirements. Fishery analyses, numerical modeling and simulation studies require access to interactive computers. Word processing, spreadsheet analysis and ad hoc data management are also required throughout the Division.

The Division uses a combination of CP/M computers, MS-DOS computers, a 32-bit computer (Stride) and the UCSD VAX to analyze pelagic fish data. There are 14 MS-DOS computers and 1 multiuser 32-bit computer within the Division; 6 La Jolla Standards and 3 ports to the Molecular receive relatively little use. The Division also employs the UCSD VAX, and to a lesser extent the Cray supercomputer, to maintain several large data bases in support of work conducted by both the Pelagic Division and the Marine Mammal Division. Several makeshift patch panels exist throughout the Division to facilitate the sharing of peripheral devices and ports to the Stride and the UCSD LAN.

The policy within the Division is to use MS-DOS computers for word processing and analyses of small data sets. The Division requires access to the UCSD VAX and the San Diego Supercomputer Center for data management, analyses, and simulation modeling. In particular, the Division requires access to significant online and offline storage for the maintenance of large data bases.

Fishery-Marine Mammal Interaction Division

The Fishery-Marine Mammal Interaction Division monitors marine mammal populations and evaluates the impact on these populations by fishing activities. Major areas of research and/or operations include 1) status of dolphin stocks in the eastern tropical Pacific Ocean and coastal marine mammal populations off California, 2) stock identification techniques, 3) density dependence of vital rates, 4) environmental correlations with dolphin distributions, and 5) photogrammetric methodologies used to measure stock assessment parameters.

The Division is dependent on the Pelagic Fisheries Resources Division for data management and extraction. However, data analyses, application of numerical methods and simulation modeling are conducted in the Division. Word processing, spreadsheet analysis and ad hoc data management are also required throughout the Division.

The Division uses CP/M computers, MS-DOS computers, the UCSD VAX and the 32-bit Stride computer in the Pelagic Division to conduct data analyses. Several small data sets of limited interest are maintained by individual researchers within the Division, although the large data sets are managed by support personnel in the Pelagic Division. There are 15 MS-DOS computers and an Apple Macintosh in active use; and 12 CP/M computers, including 11 La Jolla Standards, which are either inoperative or receive relatively little use.

The Division makes extensive use of MS-DOS computers for word processing and data analyses, although the speed of these computers when working with large data sets limits productivity. Data analyses on the UCSD VAX are limited to only the largest of problems because of budgetary restrictions.

La Jolla Support Groups

Administrative Services is responsible for personnel management, procurement, contract management, time keeping, imprest fund, travel, phone and mail management, building and grounds maintenance, and compliance with the fiscal operating plan. The group collects and dispenses information to all of the divisions and labs within the center. Several automated systems are in use by this group including remote time-and-attendance data entry, fiscal data entry and reporting, cashier sub-voucher preparation, and mailing list management. Additional systems under development will provide information on personnel, travel, procurement and inventory. The Administrative Services group requires word processing, spreadsheet and data management tools; they also require shared access to common files and the ability to transfer information between laboratories.

Scientific Reference and Editorial Services is responsible for word processing and technical editing services, library management and information searches, illustration and graphics production for the La Jolla laboratory. Their requirements include full-featured word processing and text file management programs, capabilities for file transfer, computer aided graphics production, access to high quality output devices, and access to commercial, government and academic information networks.

Automated Data Services is responsible for the design and implementation of administrative information systems and large-scale scientific data systems, the management of lab and shipboard multiuser computer systems, and the provision of training and consultation to the staff at large. In addition the group monitors all procurements of computer resources requested by anyone in the southwest region and secures administrative approvals where required. The group requires access to all systems in use by the La Jolla Laboratory.

The La Jolla support groups use the Molecular computer for word processing and a limited number of management information systems. In addition one MS-DOS computer is used by the librarian for access to information services, another MS-DOS computer is used by the illustration services group for computer-aided drawing and 2 MS-DOS computers are used by the ADP staff. Sixteen Molecular ports are distributed among the administrative services group, the editorial services group, the ADP services group and the Director's staff.

Only a portion of the management information system specified by the Executive Officer (see Appendix B) is in place. Maintenance of existing programs and a limited amount of in-house development continues on the Molecular computer while other pieces of the information system are being developed outside of the region on MS-DOS computers. Additional in-house development has been suspended until more MS-DOS computers are installed for the use of the support groups. In addition, continued dependence on the Molecular for word processing is causing the support groups to become isolated as MS-DOS computer-based word processors are being adopted by the local research staff and other groups throughout the NMFS. Computer-assisted activities performed by the support groups (word processing and management information systems) should be moved to MS-DOS computers; in addition the groups require file exchange capability, currently provided by the Molecular computer, in an MS-DOS environment.

Honolulu Laboratory

The Honolulu Laboratory monitors the recruitment, abundance and harvest of fish and crustacean populations in the western Pacific; the Laboratory also monitors the recovery of monk seal and marine turtle populations. Major research areas include 1) recruitment and stock assessment of insular and seamount associated populations; 2) physiology, movement, and population dynamics of pelagic resources; 3) habitat enhancement and degradation and the effects on fish productivity; 4) fishery economics; and 5) marine mammal and endangered species. In addition, fish landings from Hawaii, territorial and commonwealth governments in the western Pacific are collected and maintained on small computers by the Honolulu Laboratory; this database is referred to as WPACFIN.

The Laboratory's work is heavily dependent on the maintenance and interrogation of numerous small- to moderate-sized data bases. Data entry, editing, and archiving are conducted by a central support group; data extraction and analyses are conducted by individual research groups. This arrangement is satisfactory for current and future requirements. Thus the primary requirement is for easy access to centralized data management throughout the laboratory. Other requirements include statistical analyses, numerical modeling, word processing, graphics production, and support for administrative tasks.

The laboratory employs a communications switch to connect approximately 40 terminals with a Molecular computer and its peripheral devices, a Compupro CP/M computer or the University of Hawaii computer center. A Mohawk computer, which uses a proprietary micro processor and operating system, is employed for data entry and transfer to the university computing center. In addition, 15 MS-DOS computers (IBM AT's) are distributed throughout the laboratory; several of these are used as terminals connected to the communications switch. The Molecular is used to post financial transactions, word processing and large data file transfer; the MS-DOS computers are used for word processing, data analyses and scientific computing. File exchange is accomplished by using the Molecular as a common ground.

The trend at the Honolulu Laboratory is toward increased use of the MS-DOS computers for all computing needs; this class of computers meets most of the current and anticipated requirements and more should be acquired. For scientific computing and analyses of large data sets, a 32-bit computer should be procured and connected to the communications switch. The Mohawk system should be maintained for the indefinite future; many data entry activities appear to be most appropriately conducted by the laboratory staff. Future plans should also include replacing the Molecular with a file server linking the MS-DOS computers and providing shared access to programs, data files, peripheral devices, and the communication switch. In the meantime, the current use of portable magnetic media to backup, store and transfer files between the MS-DOS computers is a viable and inexpensive solution.

Tiburon Laboratory

The Tiburon Laboratory's focus is on groundfish research. Species of interest are those targeted by the west coast trawl fishery and include several species of rockfish, Dover sole, sablefish and grenadier. Major investigative areas include 1) stock assessment and recruitment studies, 2) environmental influences on community structure, prey selectivity and recruitment, 3) dependence of fish health and fecundity on oceanographic conditions, and 4) underutilized resources, harvesting and processing methods.

Computer supported activities include the design and maintenance of small data bases, statistical analyses and summarization of data, numerical modeling, word processing, and posting financial transactions. Moderate-sized data sets are occasionally imported via magnetic tape media. Additional requirements include image analysis capability, lab instrumentation and enhanced support for administrative functions.

The laboratory uses independent MS-DOS computers and a multiuser Molecular computer to support its activities; no substantial work is performed on time share computing facilities. The Molecular is used to post financial transactions, for word processing, and for file transfer. File transfer is accomplished by using the Molecular as temporary data storage while data are written to or read from magnetic tapes mounted on the system's tape drive; the Molecular is also used to transfer files between MS-DOS computers connected to it (the La Jolla and Honolulu Moleculars are used for similar purposes). The MS-DOS computers are used for word processing, data management, scientific computing, and the production of presentation graphics. Shared access to documents, data, and output devices is accomplished by using floppy disks to move files between machines. Access to a modem is limited to those computers served by dedicated telephone lines that bypass the telephone switchboard (i.e. the Molecular and 3 MS-DOS computers.)

The trend at Tiburon is toward an increased use of MS-DOS computers, 19 of which are distributed among the staff. This class of computers is adequate to meet current and anticipated needs; more should be acquired. A DEC Rainbow computer and 2 La Jolla Standards are no longer used; the Molecular has 16 ports scattered throughout the facility and is also underutilized.

Pacific Fisheries Environmental Group

Research at the Pacific Fisheries Environmental Group in Monterey is directed at understanding the effects of environmental variation on marine fish populations. Environmental data are obtained from the Navy's Fleet Numerical Oceanographic Center (FNOC) and used to describe climatic events, synthesize data sets for stock-environment investigations, and develop fishery forecast models. The use of comparative methodologies requires data exchange with other regions, various state and federal agencies, and foreign governments. The staff at PFEG also distribute environmental data products to both U.S. and foreign based researchers.

PFEG's activities are numerically oriented and dependent on sophisticated computing machinery. Access is required to FNOC's data archives; a high level of interactive processing and graphic capability are also required for analysis and description. Data import and export are currently (and most appropriately) accomplished by the physical transport of magnetic media using the mail or courier service. However, if a response to a request for information is urgently needed, a modem can be used for text file transfer. Because of the group's small size and relatively low level of contractual and procurement activity, there is little requirement for automated administrative support other than word processing and the production of presentation graphics.

Four years ago PFEG installed a 32-bit multiuser computer (Charles River Data Systems) to be used for data analyses and word processing; this past year additional storage capacity and terminals were added. Several ports are available to a CDC Cyber 855/860 computer operated by the Fleet Numerical Oceanographic Center, the principal source of data used by PFEG. Two laser printers, a plotter and a modem are also available. Current plans call

for upgrading the microprocessor and the addition of two graphic workstations to the system.

Financial transactions are posted interactively via modem to the Molecular computer in La Jolla; although this arrangement is somewhat awkward, it is tolerable considering the low volume of traffic (approximately 1 hour per month). Other than word processing, there is little justification for any of the various management information systems.

The Charles River Data Systems computer meets the current and projected needs of PFEG. System expansion plans are reasonable and consistent with the evolution of 32-bit computers.

Southwest Regional Offices

The Southwest Regional Office (SWR) is responsible for the implementation of regulations governing fishery development and management, habitat conservation, and marine mammal and endangered species protection. The office is divided into three divisions: Management, Development and Enforcement.

The Management Division monitors fishing activity, marine mammal populations, and potential impacts on identified habitats; they review information from a variety of sources and recommend regulatory action where appropriate. In addition to the office in Terminal Island, the Division has personnel in San Diego to monitor porpoise mortality in the tropical tuna fishery and in Santa Rosa to monitor activities affecting estuarine habitats. The Division requires word processing, spreadsheet and data management tools as well as access to remote data bases and small file transfer capability.

The Development Division manages approximately 200 fishery loans, produces three weekly publications for approximately 600 subscribers, and maintains data bases on tuna imports and fishing fleet activity. They require word processing and spreadsheet tools as well as access to remote data bases.

The Enforcement Division maintains offices in Terminal Island, Santa Rosa and Hawaii with field agents located in San Diego, Eureka and Monterey. The Division's requirements are for word processing and access to enforcement data bases.

The Western Pacific Program Office in Honolulu monitors activities that affect fisheries development, habitat conservation, and protected species in the western Pacific region. The office requires word processing, spreadsheet and data management tools as well as access to remote data bases and small file transfer capability.

Over the last two years the SWR has implemented the first two phases of the Southwest Region Information and Telecommunications Plan, dated May 22, 1984 (see Appendix B), which calls for the installation of MS-DOS computers and office automation software (first phase), establishment of local clusters of computers connected for the purposes of data and printer sharing (second phase), and the establishment of a full-featured local area network (third phase).

The Director's staff employs a three-station network consisting of an MS-DOS computer, two terminals and a laser printer. The Executive Officer uses a portable MS-DOS computer, and the ADP support staff employs an MS-DOS computer and two terminals. Two MS-DOS computers, one portable and one fixed, and a graphics terminal and plotter are available to the staff in the user's room. These machines are used for word processing, budget analysis, local and remote data base management.

The Management Division uses a token ring network linking 5 MS-DOS computers, printers and modems. The Enforcement Division has an MS-DOS computer that can link via modem to similar computers used by field agents in Honolulu and Santa Rosa; these machines are used to access the federal and state enforcement data bases. The Development Division employs a four-station network consisting of an MS-DOS computer and three terminals to manage the fishery loan program. To produce three weekly publications providing market news, the Development Division uses another MS-DOS computer to gather information via modem. A dedicated word processor, mimeo machine and address machine are used to compose and reproduce the copy. The latter equipment is obsolete and should be declared surplus when the market news service is discontinued.

The Santa Rosa Regional Office and the San Diego Regional Office are each equipped with two MS-DOS computers. They are used for word processing and budget planning, and in San Diego, to monitor the porpoise kill quota. The Western Pacific Program Office in Honolulu has three MS-DOS computers.

In total, the SWR has 23 MS-DOS computers and several terminals to support approximately 75 people (not counting observers). Most of these computers have access to hard disks for file storage and modems for communication links. In addition, three mainframe time share systems are used to access data bases; these include a DEC-20 accessed via a NOAA time share contract, a DEC VAX 11/780 accessed via contract with UCSD and a Burroughs 7800 accessed via the Northwest and Alaska Fisheries Center. Two La Jolla Standard computers are not being used.

Although the plan is not fully implemented, the arrangement at the SWR appears to be meeting the needs of the organization. Reliance on the IBM personal computer architecture has generated efficiencies in initial capital investment, installation, maintenance, and operations (although document exchange with the Washington, D.C. office is somewhat inhibited by that office's use of dedicated word processors and lack of direct file compatibility). Current plans call for moving the regional data bases to local personal computers; the national data bases and data bases shared with other agencies must remain on the NOAA time share system. Also planned is an expansion of the graphics production equipment in the user's room at Terminal Island. The local clusters are working as designed, permitting the sharing of data files, printers, and modems. The establishment of a full-featured local area network is not currently warranted and would be premature.

Summary

Several region-wide generalizations can be drawn from the above review of operations; these are listed under Functional Requirements. Responses to these requirements are summarized under Existing Solutions and Trends.

Functional Requirements

The following is a list of functional capabilities required by personnel throughout the southwest region:

1. Word Processing and Document Management

Words and numbers are the currency of business in the SWFC and SWR. Letters, memos, manuscripts, and reports are a common measure of productivity as well as the milestones by which progress toward objectives is indicated. As such, word processing and document management are of paramount importance.

A document filing system is a natural complement to electronic document preparation. A filing system should allow search and retrieval based on such information as author, date, subject, key words or text matching. Title, authors, annotations, and a history of revisions should be maintained for each document. As with the various management information systems discussed below, this system could be duplicated in several organizational units with only the data changing.

Shared access to files, storage and output devices should be considered essential. Most documents require shared access, although a few do not. Examples of the former include manuscripts, reports, letters, and memos, which require access by more than one person for editing, review, filing and/or printing. Examples of the latter are personal correspondence and informal memos and reports. High quality printers and other output devices are sufficiently expensive and technically sophisticated as to require shared access among several users. The quality and consistency of the appearance of documents are thus improved, and the maintenance workload of the technical staff is more focused. Printers connected to individual computers are appropriate for draft output and should be the responsibility of the individual user.

2. Management Information Systems

Administrative functions are ideally suited for automation where consistency is highly valued, procedures are exactly specified, access to common data files reduces redundant data entry and provides cross checks for error detection, and there is a need to monitor ongoing activities. To assist administrative personnel, several management information systems have been developed in the southwest region and more are being developed by NOAA's service units. These include time keeping and reporting, procurement tracking, contract management, personnel management, financial planning and tracking, and project planning and tracking.

The data bases supporting these systems should be centrally located for three reasons: 1) to ensure the accuracy, timeliness and integrity of the data,

2) to facilitate layered security protocols to prevent unauthorized access and/or alteration of the data, and 3) to enable easy access by the Director's staff, the administrative staff, division chiefs and task leaders. For practical considerations many of the information systems should be duplicated in La Jolla, Honolulu, Tiburon, and Terminal Island.

3. Data Management

Substantial data management activities are conducted by all organizational units. The data bases are expected to grow considerably, albeit predictably, as surveys continue, domestic fishing increases, and reporting systems improve. The maintenance of these data bases using time share computers consumes more ADP resources than any other ADP activity. Considerable savings can be achieved by moving these activities to the laboratories and regional offices (see Appendix A); however, shared access to central data repositories is a necessary prerequisite.

4. Data Analysis and Modeling Capabilities

In each of the organizational units there is a requirement to perform analyses on relatively large data sets; requirements also exist for numerical modeling and simulation studies. Like the data management activities, it is cost effective to move these functions to computers located in the laboratories. Requirements include machines with virtual memory operating systems configured with data analysis packages, graphic display programs, and high level language compilers. Shared access should be available to all potential users.

5. Communication Links

Each laboratory and each regional office should have reliable data communication capabilities. In the case of the SWFC, the laboratories should be linked to each other and to the administrative center in La Jolla for transferring documents and financial data. In the case of the SWR, each field office should be linked to the Terminal Island office for transferring documents and for gaining occasional access to enforcement data bases. There is a further requirement that La Jolla and Terminal Island have a communication link with the NMFS offices in Washington, D.C. for transferring documents. Other communications requirements include access to time share computing facilities, wide area networks and information services.

In all cases these needs can be met with existing telephone lines and high-speed asynchronous modems (e.g. 9600 bits per second.) The current and anticipated traffic does not justify the additional cost of dedicated communication lines and synchronous modems. It is not cost effective to procure and maintain high speed modems for every potential user. Rather this equipment should be available by shared access.

6. Shared Access to Computing Resources

The common theme appearing in all of the above general requirements is shared access to computing resources. These resources include word processing functions, management information systems, data archives, scientific computers, and communication facilities.

Existing Solutions and Trends

The table below summarizes the gross distribution of personnel, equipment, data, and time share costs throughout the southwest regional area.

Division/ Laboratory	Personnel ² ADP		Small Computers ³			Molec ₃ Port ³	Data ⁴	Time Share ⁵
			CP/M	MS-DOS	32-bit			
Coastal	35	2	9	15	0	8	70	60
Pelagic	16	4	6	14	1	3	110	20
Marine Mammal	16	1	12	15	1	0	250	50
Support Serv.	26	4	0	4	0	15	5	20
Honolulu	52	3	1	15	0	25	150	30
Tiburon	28	1	12	8	0	16	60	0
PFEG	9	0	1	0	1	N/A	3500	12
Regional Off.	75	1	2	23	0	N/A	920	60
								252

Explanatory notes:

1. The Director's staff is included under "Support Serv."
2. I counted only full-time permanent employees under "Personnel." Of this number, those whose duties are primarily associated with computer support are tabulated under "ADP."
3. The distribution of "Small Computers" is listed by the classifications described above. The distribution of ports to the Molecular computer is listed where applicable.
4. The aggregate amount of "Data" that each division/ laboratory maintains or accesses is listed in megabytes. Although the Pelagic Division maintains the large marine mammal data bases, the costs are assigned to the Marine Mammal Division. See also Appendix D.
5. "Time Share" costs are estimated for the current year in thousands of dollars.

The deployment of computers and their use throughout the southwest regional area has been in a state of flux since 1982, when a plan to procure mini computers for La Jolla and Honolulu was abandoned and a migration to small computers was initiated (see Appendix B). This resulted in the design and distribution of the La Jolla Standard computer and the installation of Molecular multiuser computers in the La Jolla, Honolulu and Tiburon laboratories and on the NOAA Ship David Starr Jordan. Subsequently, a piecemeal movement to MS-DOS computers has occurred among the research staff, and NOAA has adopted the MS-DOS architecture as a standard. The existing solutions and trends in the southwest regional area may be summarized:

1. Throughout the southwest region there is an increased use of small computers for performing a variety of tasks previously accomplished with dedicated machines, large time share computers, calculators or not at all.
2. There is a shift away from the use of CP/M computers toward MS-DOS computers. The rate of migration is uneven among the laboratories and divisions with the support groups lagging behind.
3. With the Stride computer in the Pelagic Division and the Charles River Data Systems computer at Pacific Fisheries Environmental Group, 32-bit computers have been introduced successfully for scientific computing.
4. Nevertheless, most of the money associated with computer support is still spent on time share systems for management and analyses of large data sets.

REQUIREMENTS STATEMENT

This section contains a general description of the information systems required to support operations in the southwestern regional area. Several planning assumptions are stated and briefly discussed in terms of their implication to the region. Requirements and options are then presented; organizational units are considered separately where appropriate.

Planning Assumptions

The following assumptions reflect conditions and trends external to the region; they are discussed first in general and secondly as to the implications to the region.

1. Distributed Processing

The most dramatic and pervasive trend in the use of computers over the last ten years is the shift away from centralized data processing using a few large machines to distributed processing using many smaller machines. Batch processing has yielded to interactive processing, single large mainframe computers have been replaced with clusters of mini or departmental computers, and multiuser systems have given way to networks of single user computers.

A corollary of this trend is that large investments in computing systems, amortized over several years, are being replaced by more numerous smaller investments that are rapidly written off. One result is increased flexibility and capacity to trade old technology for new improvements; another result is that technological innovation is driven by market pressures, which further accelerates the trend. A case in point is the introduction of small computers, which was first considered to be a predictable outcome of the trend toward distributed processing. However, the low cost of these machines facilitated a dramatic increase in the number of users; their expectations fueled technical development and the use of small computers for tasks formerly only practical on much larger machines. This was possible because the market became broad enough to enjoy the economies of large-scale production and distribution; a big market rewarded the development of cheaper and more powerful machines, which in turn further expanded the market. As the distinction between consumer electronics and traditional computing machinery becomes less clear, the cost of hardware acquisition becomes less important than the cost of transporting applications and data to the new equipment.

A number of recent articles³ have noted similar performance/price ratios over a wide range of computing equipment. The authors conclude that it is most effective to accomplish any task on the least powerful type of computer capable of performing it; the trends toward decentralization and distributed computing are practical applications of this conclusion.

3. Phillip Ein-Dor, "Grosch's Law Revisited: CPU Power and the Cost of Computation," 1985, Comm. ACM 28(2):142-151; George F. Colony, "New Ports of Call," Datamation, 11/15/86:69-74; Gordon Bell, "Preparing for Changing Scientific Computing Environments," position paper by the Assistant Director, National Science Foundation, 9/30/86.

By illustration, annual expenditures in the southwest region for time share services have steadily decreased over the last 8 years from \$464k in FY 1979 to \$206k in FY 1986. At the same time, yearly investments in small-computer hardware and software have increased from \$10k in FY 1979 to \$321k in FY 1986. During this period the region dramatically increased its reliance on automated data systems for information; reflecting this trend, the number of full time personnel (both temporary and permanent) involved in data management activities increased from 10 to 21. Discounting for inflation, ADP costs actually decreased while computers were used more than ever before.

Implication to the region: The most efficient and flexible information system is one that de-emphasizes large capital investments for singular solutions. This has been the recent practice in the region and the trend should continue; some solutions turned out to be mistakes while others were able to take advantage of changes in the small computer marketplace. The guiding philosophy should be distributed processing with shared access to resources, including storage devices, output devices, special-purpose computers and communication servers.

A local area network (LAN) is now the most important element in the information system because it links small computers with their data files, it provides universal access to printers and plotters, it allows shared access to scientific computers and it serves as an efficient gateway to the world outside of the laboratory/office. Equally important, a network also establishes a protocol for compatibility and a rational framework for developing and managing computer resources.

The relative value of investments in hardware and software changes as applications are moved to smaller computers. The maturation of the small computer market requires a consumer oriented view of technology and procurement planning. Thus, when developing information systems, a primary consideration should be the portability of the programs and the supporting data bases to other machinery.

2. Distributed Responsibility

The Management Review, cited at the beginning of this document, concluded that decentralized ADP operations were advantageous for several reasons. The Review noted that data integrity, analytical accuracy, and rapid response times were best achieved by distributing data management responsibilities to the divisions and tasks. This operational philosophy complements the general trend of distributed processing discussed above.

Implication to the region: The individual researcher is the best qualified to determine the appropriate mix of computational tools required to support his project. Accordingly, the acquisition of these tools should be funded at the division or task level. The Director, through Automated Data Services, should provide the communication links and services required to access data bases and other information sources, transfer files and use peripheral devices. The Director should also provide general specifications, guidance and authority for procurement.

3. Endorse Vendor-Independent Standards

No single word processing product is appropriate for the management, administrative and research staffs. Even within these groups individual requirements and work habits vary sufficiently to warrant the use of different programs. A single word processor, with enough features to meet all possible requirements, would be expensive, relatively inflexible, and require substantial investment in training. Similarly, there is no reason to expect that word processing requirements and preferences will be static through time. It is almost a certainty that new products will better meet current requirements and that those needs will evolve as technology raises expectations. This will be particularly evident as page composition features (including font selection, page formatting, and graphics) are introduced into traditional word processors.

Implication to the region: Standard file formats⁴ and communication protocols should be observed regardless of the word processor employed. An alternative strategy is to follow the recent recommendation of the NMFS National Data Management Committee to standardize on the file format used by the Word Perfect word processor; this product is available on MS-DOS computers and some 32-bit computers.

Similar arguments can be made for data base application languages. Different languages are used because of programmer preference, historical use, familiarity, and availability. Rather than impose the use of a single product on application developers, it may be wiser to specify that the language used incorporates a standard set of primitive commands recognized by a large number of products in a variety of computing environments.

Implication to the region: Standard Query Language (SQL)⁵ should be an integral part of any data base language used to build information applications. This allows the use of these products to expedite development time while providing portability to other computers using different data base languages. Although inefficient for application development, FORTRAN77 has a high degree of portability and should be used where appropriate.

4. Endorse Use of DEC Equipment

The SWFC research staff strongly endorses the use of DEC equipment for data management and scientific computing activities for four reasons: 1) the substantial investment in data dictionaries, archiving, and retrieval routines that are not easily transported to another environment; 2) the significant technological lead that DEC enjoys in this class of computers, and the healthy scientific software industry that supports the DEC line; 3) the lead that DEC enjoys in the area of connectivity to small computers and distributed

4. For example, Document Content Architecture (DCA) specified by IBM to facilitate the exchange of formatted documents between different word processors operating on different classes of computers. Several MS-DOS word processors, including Word Perfect, support this format.

5. Standard Query Language, originally specified by IBM, is supported by a large number of data base languages operating on mainframe, mini, and micro computers, including PC Focus and dBASE III on MS-DOS computers.

processing; 4) the use of the same operating system on all classes of equipment.

Implication to the region: DEC products (VAX and MicroVAX) should be given preference when selecting computers to support data management and analyses. This will cause the least disruption to ongoing activities, allow operations to continue in a recognized science and engineering environment, and afford the research staff compatibility with many of their colleagues outside of the region.

5. Information Technology 1995

Information Technology 1995 (IT 95) refers to a national initiative to provide computer services to NMFS. The concept design specifies four regional computers and another computer servicing the Washington, D.C. offices, linked together with dedicated telecommunication lines. A requirements initiative, including benchmark specifications, a telecommunications study, and a conversion plan, will be issued in April 1987. Pending approval from the Department of Commerce and funding (total funding estimated at 10-12 million dollars with 3 million dollars expected to be appropriated in 1988), a request for proposal will be issued in October 1987. The system is expected to be in place by the end of fiscal year 1989.

Implication to the region: A regional computer has the potential of greatly reducing the current costs associated with managing and analyzing large data sets. The initiative should be closely monitored to ensure that it meets the needs of the region. In the meantime, several options are available to manage data and reduce time share costs.

Requirements and Options

As noted in the section on Mission and Organization, the laboratories and offices of southwest region of NMFS need only to be connected by modem and existing telephone lines. Information extracted from data, not the raw data itself, is exchanged between laboratories and offices. As such there is no justification for a region-wide network. However, within each laboratory and office there is a need to establish an integrated information system. As in the preceding sections, the discussion of requirements will treat organizational elements separately, recognizing that there is no single solution appropriate to all of the laboratories and offices.

I will begin with a discussion of the three functional uses of computers in the region: office automation, scientific computing and data management. Local area networks will be considered next. ADP mission, staffing and organization are discussed last.

1. Office automation

Office automation activities include word processing, spreadsheet analysis, small data base management, graphics production, and the use of a variety of personal productivity tools. Also included in this category are administrative information systems such as financial reporting, time keeping, cash management and inventory control. Over the last several years these activities have migrated to small computers, reflecting a more general trend

throughout business and government. This trend has established a large consumer demand for better solutions at cheaper prices. For the next several years the development of new products will be driven by market demand rather than the possibilities of technology.

The implication to any organization that is planning office automation is clear: Investments in office technology will be protected to the extent that market trends are followed. Conformance to commercially successful solutions will be rewarded; innovation will not be. This is because cheaper and better software will be marketed to the mass of existing users, improved peripheral devices will be configured for the bulk of existing systems, and new hardware architectures will generate a market for upgrades to existing configurations.

In the southwest regional area, office automation functions should migrate to MS-DOS computers. This movement should be encouraged at all laboratories and offices with the exception of Monterey, where these functions are supported by a 32-bit computer. In addition, market trends should be monitored for guidelines in writing procurement specifications; software purchases should be confined to a few popular and well-supported packages; and hardware acquisitions should be considered carefully, weighing the low cost of "cloned" hardware against the flexibility and potential of new offerings from established vendors.

Because it is not cost-effective to upgrade the Molecular to MS-DOS computers, they should be phased out. However, immediate action is neither warranted nor advisable. The word processing product (Wordstar), currently used as a standard throughout the region, is available for both CP/M and MS-DOS computers and recognizes document files from either operating system. As long as Wordstar remains the standard word processor, there is no need to abandon the Molecular. Furthermore, the Molecular network is the only means of exchanging files in Tiburon and La Jolla; until other networks are established in these two locations the Molecular is required to provide this service.

An MS-DOS computer definition should be established for procurement specifications and periodically reviewed. The current definition should be IBM AT compatible with a high resolution graphics display. Although a variety of reasons can be listed to support AT compatibility as a minimum standard, ultimately only two are of importance to the southwest region: 1) AT compatibility represents the current evolutionary state of the MS-DOS computer market and 2) existing MS-DOS programs, applications and data are fully supported.

2. Scientific computing

Scientific computing includes numerical modeling, simulation studies and statistical analyses of large data sets. These activities, conducted in the past on large computers, have started to migrate to 32-bit computers such as the Stride in La Jolla and the Charles River Data System in Monterey. As in the case of office automation, this is a reflection of a more general trend in the science and engineering communities.

The scientific computing needs of the research staff can be met with 32-bit computers augmented by access to the facilities of the San Diego

Supercomputer Center. These machines should be considered as multiuser resources to be procured when and where program needs dictate. Of particular interest is the MicroVAX II, which can be configured with the same statistical analyses programs currently used by the staff on the UCSD VAX 11/780.

In La Jolla, a Stride computer with 8 ports is currently used by 2 people in the Pelagic Division; expanded use of this computer for scientific computing should be encouraged. Additional 32-bit computers should be acquired for the Marine Mammal Division and the Coastal Division; each computer will require the part-time services of one of the research staff as system administrator. Alternatively, a single VAX 8250 or MicroVAX II can meet the current needs of the entire La Jolla Laboratory (see Appendix A). Access to these machines, however, will be inhibited until a local area network is installed.

The Tiburon Laboratory has a limited need for a 32-bit computer, although changes in their research tactics may require greater computing power in the future. As with La Jolla, shared access will be awkward until a network is installed.

The Honolulu Laboratory could make immediate use of a 32-bit computer for data analyses and modeling. The machine should be made available to all users through the communications switch.

Pacific Fisheries Environmental Group in Monterey is currently using a 32-bit multiuser computer to meet all of their computing needs, with the exception of data archiving provided by FNOC. The group could make immediate use of additional 32-bit computers for graphical data analyses and presentation.

3. Data management

Data base management includes the archiving, updating and interrogation of large data sets. The same factors that caused office automation to move from departmental computers to small computers and scientific computing to move from mainframes to graphic workstations are driving the development of micro-based data management machines, namely, low initial cost and flexibility. This is where the real potential of the 32-bit processors will be tapped and the market will expand accordingly.

This industry trend must be considered when choosing an option for supporting data management prior to the implementation of IT-95 (the proposed NMFS computer system outlined above). It may be prudent to pursue time share contractual arrangements until a regional computer becomes available. It is certainly most cost effective, however, to lease or purchase 32-bit machines designed for data management and incorporation into networks of small computers.

The La Jolla Laboratory's contract with UCSD will expire at the end of fiscal year 1987. Current plans estimate that the IT-95 computer system will be in place by the end of fiscal year 1988. In the meantime several options are available for providing data management support:

Extend the UCSD time share contract contingent on the installation of a NMFS system. Through UCSD, access is provided to VAX 11/780's in the computing center, a VAX 11/785 at Scripps Institution of Oceanography, and the San Diego Supercomputer Center. Extension of the contract has the advantage of uninterrupted service, although at a premium price. Because another move is anticipated, it may be the least disruptive to the research staff.

Competitively contract for VAX time. This option would likely result in a lower cost than UCSD, although it would involve moving data and applications to another facility as well as uncertainties regarding the level of service at the new site.

Purchase and/or lease MicroVAX's and other 32-bit computers. This is the most cost effective alternative. The lease of a MicroVax II and software for each division can be supported by the current annual outlay for time share costs with several thousand dollars left over (see Appendix A.) However, one full-time person for each machine would probably be required for system administration.

It should be noted that continuation of the contract with UCSD, at some level, is highly desirable so that access may be maintained to expensive computer resources. These include specialized software, high-resolution plotters and printers, large-capacity tape drives, technical consultation service, and the facilities of the San Diego Supercomputer Center.

The Tiburon Laboratory has eliminated its dependence on time share systems. The data sets used to support their work can be managed by their MS-DOS computers, albeit at slower speeds than possible on time share systems; these data sets are archived on magnetic tape via the Molecular computer. As with scientific computing, data management can be accomplished with a 32-bit computer, although full realization of this potential is not possible until a network is established.

The Honolulu Laboratory has significantly reduced its dependence on the University of Hawaii's time share facility. However, all data entered through the Mohawk system is first transferred to the university computing center where it is transcribed to magnetic tape and then imported to the Molecular. From the Molecular, data may be ported to one of the MS-DOS computers and stored on fixed or portable magnetic media; back-up storage exists on the original magnetic tape. Although moving data files between the Molecular and an MS-DOS computer can be time consuming, the arrangement is satisfactory for the majority of needs. A 32-bit computer, equipped with a tape drive and accessible through the communication switch, could meet both the data management and scientific computing needs of the laboratory.

The Pacific Fisheries Environmental Group at Monterey is dependent on the FNOC as a source for their data as well as its management and archiving. Data are easily extracted and analyzed on PFEG's 32-bit computer. FNOC's tape drives are used for importing and exporting large data files. Time share costs have been reduced to a minimum and the operation is quite efficient.

The Terminal Island Regional Office has recently taken on the responsibility of maintaining a large data base of fish landing receipts referred to as the

"PACFIN Research Data Base." The data base is updated annually with data supplied by the states; data extractions are conducted at irregular intervals for economic research purposes. The data base and supporting programs currently reside at the UCSD computing center. When the contract with UCSD expires the same options listed above for the La Jolla Laboratory are available to Terminal Island. An additional option is to move the data and programs to the Burroughs computer operated by the Northwest and Alaska Fisheries Center in Seattle. The data are flat ASCII character files and the programs are written in FORTRAN77, so that the entire system should be portable from one machine to another. The FIN data base, updated biweekly, is already maintained on the Burroughs computer and the State of California has relaxed its policy on prohibiting fisheries data from leaving the state.

4. Local Area Networks

The single most important element in an efficient and flexible information system is the network that connects the components together. The network enables shared access to all computing resources, establishes protocols for compatibility, and provides a rational basis for retiring old machinery and acquiring new equipment as a continual process -- rather than wholesale replacement.

La Jolla laboratory

The design and installation of a local area network in the La Jolla laboratory should be accomplished with the following goal: Each terminal (or personal computer) connected to the network should have access to all other connected devices; these include printers, plotters, file servers, communication servers, and multiuser computers.

As part of a recent telecommunications study, a network design was prepared for the La Jolla Laboratory. Requirements were defined, technical specifications were prepared, a request for vendor proposals was drafted, and criteria for evaluating vendor response were elaborated. The functional requirements for a local area network are listed in Appendix C.

Honolulu Laboratory

Personnel at the the Honolulu Laboratory currently enjoy shared access to computer facilities through the communications switch. Terminals and MS-DOS computers, acting as terminals, are connected directly to the switch and users may select access to the Molecular computer and its peripherals, to the Compupro computer or the University of Hawaii computing center. Although this arrangement meets current needs, it only allows access to output devices and file storage through the Molecular. Large data file transfer between the university computing center and the MS-DOS computers must also be accomplished via the Molecular.

The Honolulu network may be upgraded by linking the MS-DOS computers with a file server, magnetic tape drive, output devices, and access to the communications switch. The Molecular may be maintained to support word processing and administrative information systems until the laboratory moves to an MS-DOS computer-based word processor. At that time, additional MS-

DOS computers may be added to the network replacing the remaining terminals.

Tiburon Laboratory

Personnel at the Tiburon Laboratory are satisfied with their current level of connectivity. The Molecular computer has ports scattered throughout the four buildings that house elements of the Tiburon facility, and this network is used for importing large data files via magnetic tape, exchanging documents between those using the Molecular as a word processor, and gaining access to remote systems via modem. The MS-DOS computers are not directly connected to each other; these computers can be used as terminals to the Molecular and can exchange files via this connection. More often, file exchange and device sharing are accomplished using floppy disks as the common medium.

Because the Tiburon Laboratory is housed in four buildings, a physical network connecting devices throughout the facility would be expensive, redundant and not warranted by current operational requirements. A proposal to move the Tiburon Laboratory to Bodega Bay is currently being considered. If a new facility is built at Bodega Bay, network wiring should be installed during construction. At the current facility, groups within a single building may be connected using inexpensive networks marketed for small groups (see the SWR Terminal Island Office for examples), although the decision to implement such a scheme is best considered by the Laboratory.

Another possible option is to replace the Molecular with a 32-bit computer to be used for scientific computing and data management. The star network wiring in place to support the Molecular could be used to provide multiuser access to the 32-bit computer.

Pacific Fisheries Environmental Group

The Pacific Fisheries Environmental Group employs a multiuser 32-bit computer with ports for printers, plotters, modems and connections to the FNOC computer. Additional devices (e.g. graphic workstations) may be added to the system without major modification. This is a well designed system with adequate provisions for future expansion.

Southwest Regional Offices

The regional office at Terminal Island has installed two MS-DOS computers as multi-user systems and established a token ring network connecting five other MS-DOS computers. These arrangements are inexpensive solutions to requirements for document exchange, data and device sharing. There is currently little justification for installing a more sophisticated network throughout the Terminal Island Office, although this analysis should be periodically re-examined. If a network is installed, first consideration should be given to duplicating the La Jolla network topology and control software. The experience gained in La Jolla while diagnosing performance, balancing loads, connecting devices, and configuring the control software may be thus exploited.

The other regional offices are not large enough to realize any advantages from connecting their computers together.

5. ADP Mission

There are at least three views of the services that Automated Data Services (also known as ADP) should provide. One view holds that ADP should provide all services to all divisions and laboratories, including communications, data management, application development, and technical advice. Another view is that ADP should primarily support Administrative Services and the Director's staff; these groups have little technical expertise and rely heavily on ADP for support. A third view is that ADP should maintain the linkages between hardware and provide technical advice; data management and application development are program responsibilities.

The first view requires active management of human resources to resolve priority conflicts and assure satisfactory service to all units. Whenever this control has broken down, individual programs have developed their own competence and assumed responsibility for their data. The second view restricts the activities of ADP; however, it is formed from the premise that ADP should support those groups which in turn support the entire center, namely administrative, reference, editorial and illustrative services, and the Director's staff. The third view is most closely aligned with the Management Review cited in Section II. As stated above, the Review noted that data integrity, analytical accuracy, and rapid response times were best achieved by distributing data management responsibilities to the divisions and tasks; and that productivity and morale among the programming staff were highest when they contributed to the solution of a scientific problem over a prolonged period of time.

I also hold the third view and recommend that Automated Data Services have three elements in its basic charter:

- a. Provide and maintain shared access to computing resources. This broad mandate includes responsibilities for connecting desk top terminals and computers to data archives, communication facilities and scientific computers.
- b. Technical advisory service. This mandate implies current market awareness and dissemination of information to those who make procurement decisions. The kind of questions that such a service would answer include: should we buy now or wait; which vendor delivers the best value; will this product work with others that we are using; should we pursue site licenses or volume discounts?
- c. Technology transfer service. This mandate implies awareness of current technology, operational methods employed throughout the southwest region, and the relevance of one to the other. The kinds of questions that such a service would answer include: is there a cheaper, easier or more efficient way to do something; what is the least disruptive and most demonstrative approach for introducing a new way; has the technology changed or the market expanded sufficiently to cause reconsideration of ways previously rejected?

Not included in this charter is application development, which should be the responsibility of the division/program. ADP's first responsibility should be to provide connectivity and technical consultation services to the entire staff. Such services should include maintaining communication links, assisting task leaders in equipment and software selection, advising the Director on purchase approval, installing and setting up new gear, and investigating new technologies, software and services.

6. Staffing and Organization

The Management Review noted that the current decentralized organization of ADP support was optimum and should be retained; that centralized leadership and planning was lacking; and that a permanent ADP staff, augmented with temporary student interns, would provide incentive for the professional staff and flexibility to meet short-term needs. I agree with these conclusions and suggest that division chiefs and laboratory directors be encouraged to immediately implement the most efficient organization specified by the management review team.

La Jolla laboratory

The ADP support staff in La Jolla should consist of at least four people with responsibilities as outlined below. This should represent the core staff which would be augmented with student interns and other temporary help.

The Regional Data Base Administrators's (RDBA) position, currently vacant, should be redefined and filled. The incumbent should provide leadership and direction to the laboratories, divisions and offices seeking to improve their use of information technology. To do so he/she should be personally familiar with the work performed by these units and use the ADP staff for technical advice. The RDBA's primary responsibility should be to prepare, update and communicate a tactical plan. The plan should contain detailed time and cost schedules for implementing the strategy outlined in this document. Such a plan would allow the rational development of information systems by outlining acquisition phases and options, by defining opportunities for large discount purchases, and by elucidating the consequences of funding decisions. This is the next step and the single most important recommendation contained in this document.

The Supervisory Computer Systems Analyst in La Jolla should maintain those duties associated with coordinating activities and providing advice, and pass the responsibility for information systems to the appropriate organizational unit. Additional responsibilities should include communications and network maintenance, small systems support, technical advice, and technology transfer services.

A small-systems analyst should be designated within the La Jolla ADP task to provide small computer support. Duties would include software installation and maintenance, setup and installation of peripherals, design and installation of menus and user interfaces, hardware, software and systems consultation. The objectives would be to 1) achieve better utilization of installed technology and thus improved productivity; 2) transfer of technical solutions between divisions; and 3) distribute computer resources appropriately and equitably.

A network administrator should be designated within the La Jolla ADP task. Duties would include maintaining communication links, monitoring activity and adjusting the network for optimum performance; duties would also include connecting new devices and expanding the network.

Responsibility for the development and maintenance of management information systems should be shifted to the Executive Officer. The position of budget analyst on the Executive Officer's staff could be expanded to include application development. In addition to operating the FRS, this person would be responsible for developing and maintaining other management information systems. He/she would act under the direction of the Executive Officer who would provide system specifications, set priorities, schedule work, and accept and implement the systems as they are completed. It is expected that several MS-DOS computer-based information systems will be developed outside the center by NOAA's Western Administrative Service Center and the U.S. Department of Agriculture (responsible for processing the NOAA payroll). Although these systems may eliminate some of the requirements for local development, the budget analyst/application developer would be expected to install the systems, modify them to accommodate SWFC circumstances if necessary, and ensure their continued operation.

Honolulu Laboratory

The personnel structure of the ADP task in the Honolulu Laboratory appears to be satisfactory. As mentioned in the Management Review, several of the temporary positions should be converted to permanent. Position descriptions should reflect actual duties and responsibilities; requests for grade re-classifications should be made accordingly. Several individual tasks could benefit with the addition of professional-level programmer analysts; task leaders should be encouraged to convert existing positions and/or positions should be requested where appropriate.

Tiburon Laboratory

ADP support in Tiburon appears to meet the needs of most of the staff. Increasing emphasis is being placed on small systems support, and this trend should continue.

Pacific Fisheries Environmental Group

ADP support in Monterey is performed by the research staff; to the extent that interest and competence can be maintained within the staff, this arrangement is ideal.

Southwest Regional Offices

I agree with the Management Review's recommendation that the ADP manager, who is responsible for computer support to the regional offices, report to Regional Director and not to the Center Director. This would ensure that assignment of work and its evaluation are the responsibility of the same person.

SPECIFIC RECOMMENDATIONS

In this report I have suggested that the computer needs of the southwest regional area can best be served by establishing a networked suite of computational tools in each laboratory/office (as opposed to a single large computer for the entire region). Of all the laboratories and offices, the La Jolla Laboratory is most in need of attention. Several simultaneous actions should be initiated to begin implementing this strategy: delegate responsibility to a single person, install a network in the La Jolla Laboratory, connect MS-DOS computers, add 32-bit computers, and define the role of ADP in relation to the network and future development. The following specific recommendations should be considered for immediate action.

Appoint a Regional Data Base Administrator (RDBA)

Direct the RDBA to formulate an equipment procurement and installation plan, including funding and scheduling details. Submit this plan and the supporting strategic plan for approval and the authority to proceed.

The IT-95 initiative is expected to receive 3 million dollars in fiscal year 1988, or approximately 600,000 dollars for each of 5 regional computer installations; an additional 7-9 million dollars is expected in future years. The Director, SWFC, should request that a portion of this amount be used for the regional computer and the other portion be used to develop solutions to local requirements identified in this document.

Install local area networks

Install a local area network in the La Jolla Laboratory, providing universal access to all computing resources.

Drawing on the La Jolla experience, prepare plans for a similar installation in the Honolulu Laboratory.

A network installation in the Tiburon Laboratory is not currently justified. If a new facility at Bodega Bay is built, it should incorporate a network in its design.

The Southwest Regional Office has clustered several groups of computers and peripheral devices together; there does not appear to be any current need to establish an integrated office-wide network, although this conclusion should be periodically re-evaluated.

Move operations from CP/M to MS-DOS computers

Install MS-DOS computers for the use of the Director's staff, the administrative support group and the ADP support group in La Jolla. Because these groups are dependent on the Molecular for shared data file access and document transfer, this action should be concurrent with the installation of a local area network.

Install MS-DOS computers for the use of the administrative staff in the Honolulu and Tiburon Laboratories. Document transfer will be by floppy disk until local networks are established.

Install software on the 32-bit computer in Monterey that will enable the use of MS-DOS applications for financial reporting and formatting documents for transfer.

Move the Financial Reporting System and other management information systems to MS-DOS computers.

Adopt the Word Perfect text file format for exchanging documents.

Dispose of the Molecular and La Jolla Standard computers as they outlive their usefulness; this includes the Molecular computer currently on the NOAA Ship David Starr Jordan.

Introduce 32-bit computers

Purchase or lease 32-bit computers (preferably MicroVAX's) for the Coastal Division, the Marine Mammal Division, the Tiburon Laboratory, and the Honolulu Laboratory. These systems should include provisions for shared access, adequate file storage and software for data management and analyses.

Reduce data management costs

Carefully monitor the Information Technology 1995 initiative to ensure that the proposed system meets the region's needs and that our data base systems can be moved to the new environment with a minimum of disruption.

Support data management in the interim by using 32-bit computers, contracting time share computers, or a combination of both.

Redefine ADP mission and organization

Redefine and emphasize the ADP mission to include responsibilities for communication links between equipment, for technical advice, and for technology transfer. Program development should be the responsibility of the individual organizational unit.

Designate a small-computer systems analyst and a network administrator within the La Jolla ADP support group.

Establish an applications developer position on the Executive Officer's staff to design and implement management information systems.

Implement the "most efficient organization" specified in the Management Review cited in the Introduction.

Appendix A: VAX Cost Comparisons

The following comparisons demonstrate that the UCSD VAX 11/780 computing environment can be duplicated in the La Jolla Laboratory for less than the annual time share charges paid to UCSD.

	UCSD VAX 11/780	MicroVAX II	VAX 8250
Memory	16 Mb	16 Mb	16 Mb
Active Users	< 10	8-24	16-64
Storage	4210 Mb	1800 Mb	1800 Mb
Performance	1.0 MIPS	0.9 MIPS	1.2 MIPS
CPU Time	90 hr/month	Unlimited	Unlimited
Initial Cost	0	\$110k	\$170k
Annual Cost	\$150k/year	\$11k/year	\$17k/year

Additional hardware for the MicroVAX II and VAX 8250 includes a system console and a 9-track tape drive. Software includes the VMS operating system, Datatrieve, FMS, BASIC, C, Pascal, and FORTRAN77. Initial costs are DEC list less 20% GSA discount; the price of storage devices accounts for 30-50% of the total cost. Access to the machines would be provided by either 1) a limited number of direct connections or 2) an unlimited number of users contending for access via a local area network.

The acquisition of multiple MicroVAX's in the La Jolla Laboratory (e.g. one for each Division) may be preferable for several reasons:

1. It is almost certain that work habits will change when constraints on the use of CPU time are removed. How they will change is less clear; it may be that a single computer for the entire laboratory would become immediately saturated.
2. Procurement could proceed in a step-wise fashion. Each machine would be configured to the specific needs of the Division, with the option to expand capabilities as needed. Divisions could learn from the experience of each other as data management operations are moved to in-house computers. Although multiple machines with limited capabilities would be more expensive than a single machine with expanded capability, funding may be easier to obtain for phased acquisition.
3. Performance degradation during periods of peak use would be less likely with multiple processors.
4. The redundancy achieved with multiple computers may allow continued service when a machine is down for maintenance. It would also allow a single researcher to monopolize the computer for a specific problem without affecting the entire staff.
5. Several clustered MicroVAX's offer the potential of true parallel processing. This offers the possibility of much more complex simulations than are currently practical on a single processor.

The following table lists the costs of machines configured for four groups: the Coastal Division (primarily data management), the Pelagic Division (primarily scientific computing), the marine mammal data management group within the Pelagic Division (exclusively data management), and the Marine Mammal Division (exclusively scientific computing). These configurations are only suggestions and are listed here for the purpose of cost comparison. As above, access to the machines would be provided by either 1) a limited number of direct connections or 2) an unlimited number of users contending for access via a local area network.

	Coastal Division	Pelagic Division	Marine Mammal Data Management	Research
Model	MicroVAX II BA123 box	MicroVAX 2000	MicroVAX II H9642 box	MicroVAX II BA23 box
Active Users	1-8	1-4	1-8	1-13
Performance	0.9	0.9	0.9	0.9
Memory	16 Mb	6 Mb	16 Mb	9 Mb
Storage	450 Mb	140 Mb	1400 Mb	150
Cost	\$50k	\$20k	\$80k	\$35k

The above configurations are not "fully loaded;" there is considerable room for expansion should existing needs be under-estimated or requirements expand. Each configuration includes a 95 Mb streaming tape drive for back-up and file transfer and operating system software.

Appendix B: Annotated Bibliography of ADP Requirement Studies, Initiatives and Reviews

ADP Requirement Study for Southwest Fisheries 1981-1985 Dated 10/28/80

A study was prepared by Systems Architects, Inc. in answer to the questions: "how can the SWFC best reduce its ADP expenses" and "how can SWFC bring its operations into line with the current, interactive state-of-the-art for computing?" The study compiled workloads for the SWFC and the SWR and proposed 7 alternative solutions. Estimated costs ranged from \$5 million to \$12 million over the five year system life. The recommended configuration was a mini computer (VAX 780) in La Jolla and another (VAX 750) in Honolulu for data management and analyses; office automation activities were not considered. Without change, time share costs were projected to exceed \$1 million/year by 1985.

SWFC/SWR ADP Initiative FY82 and FY83 Dated 5/6/81

Proposed to procure mini computers for La Jolla and Honolulu Laboratories. Pending approval and funding, installation would have been complete by June, 1982.

SWFC/SWR ADP Initiative FY 83 Dated 5/7/82

Presumed approval and funding of the previous initiative and proposed a 3-phase upgrade plan, including procurement of another mini computer in Tiburon, local networks, office automation equipment and an intra-laboratory network over a four-year period.

SWFC ADP Plans, Barrett to Angelovic memo Dated 12/2/82

SWFC Director reviewed the denial of his proposal to obtain a VAX computer for La Jolla Laboratory and another for the Honolulu Laboratory, and described the new SWFC plan for meeting computational needs. After receiving NMFS and NOAA approvals, the VAX proposal was determined to be inappropriate by DoC who suggested a micro computer solution. The Center continued to use time share services from the University of California at San Diego, the University of Hawaii, Lawrence Berkeley Laboratory, Northwest and Alaska Fisheries Center and the NOAA time share contractor. In addition, the Center built and distributed La Jolla Standard micro computers as well as procured three multiuser micro computers to be used for administrative and data management activities. This action was expected to meet the short-range needs of the SWFC. Long-term solutions were expected to be forthcoming from a NMFS-wide ADP study scheduled for completion in 1983.

SWFC/SWR ADP Initiative FY 84 and FY 85, NA-F-83-01-05
Dated 3/2/83

Proposed an integrated approach using off-site local processing, on-site micro computer networks and the Burroughs 7800 computer in Seattle. The proposal was offered as "consistent with the overall directives of NMFS, NOAA and DoC ADP management."

SWFC/SWR Office Automation Initiative FY84-85, NA-F-83-02-05
Dated 3/2/83.

Proposed to replace dedicated word processing equipment with micro computers integrated with those already in use by the research staff. Also proposed to upgrade the telephone system, records management, electronic mail, facsimile transmission, graphics production, project planning and meeting management.

Long-Range Plan
Dated 11/21/83

Five year plan (FY 84 through FY 88) defining three phases of computer integration into the southwest regional area:

- Phase 1: Installation of the Molecular supermicros and their use for file transfer, word processing, spreadsheets, and data base management using Z80 and 8088 processors; local area networks and inter-lab communications established; FRS installed.
- Phase 2: Incorporate graphics production into ADP; install Intel 80286, Motorola 68000 and National Semiconductor 16032 processors on Molecular and La Jolla standards; download tasks from VAX; implement online information retrieval and library into ADP; add hard drives and download data bases.
- Phase 3: Shift to 16 and 32 bit processors; incorporate color graphics; introduce knowledge-based systems and electronic reference library; electronic publication of data reports; computer conferencing.

Recommended consolidation of library, word processing and graphic design under ADP; establishment of office automation task force to set policy and guidelines; management of ADP activities by ADP sections at each laboratory; establishment of microcomputer training program for staff scientists; establishment of research group within ADP to monitor technological change and make recommendations.

SWR Information and Telecommunication Support Plan
Dated 5/22/84

A network of MS-DOS computers equipped with word processing, spreadsheet, data management, communications, graphics, statistical analysis and development language software was recommended to meet the requirements of the regional offices located in Terminal Island, Santa Rosa, San Diego and Honolulu. In the first phase of implementation, stand-alone computers would be installed in the various offices and long-range communications would be established between offices. In the second phase, multiuser systems would be introduced and within-office networks established. In the third phase, an integrated network, capable of exchanging voice, video and text within and between offices would be established. The cost of using networked MS-DOS computers was estimated at \$75k, whereas the cost of a VAX-based system was estimated at \$300k and the cost of a Molecular-based system was estimated at \$150k.

Administration ADP Requirements, memo from Remington to Carr
Dated 9/4/84

Executive Officer summarized his long-standing requests for information systems including:

- o Financial reporting system including graphical data display, field and La Jolla input/output capabilities, terminal access to data by "users."
- o Financial planning system for allocating current and budget year funds.
- o Resource computation system for assessing the impact of systematic adjustments.
- o Personnel system integrated into FRS and including:
 - Personnel cost and planning reports
 - Personnel listings by CYOP
 - EEO statistics
 - Retirement information and projections
 - Pay raise cost data by CYOP
 - Termination and appointment expiration listings
 - Recruitment mailing lists
 - Personnel recruitment status report (PATs)
- o Contracts log for status of contracts currently in force
- o Recurring reports log
- o Equipment inventory
- o Time and attendance report generation
- o Access to word processing system

The Executive Officer also expressed concern that sufficient progress was not being made and that a "full implementation of the Administrative reports system may not occur."

SWFC and SWR Update to DoC Long Range Plan,
Barrett to Angelovic Memo
Dated 3/15/85

Suggested that further "experiments with micro computer systems may be extremely expensive and unbeneficial," and that a mini computer would be more advantageous for data management and analyses. Noted that the A-76 study started by Arthur Young and Co. remained incomplete.

Micro-computer Use Review Committee, memo to Sakagawa
Dated 4/19/85

Discussed the current and potential use of micro computers (CP/M, MS-DOS and 32-bit computers) in answer to the Oceanic Division Chief's inquiry as to "what options should be considered if our use of the UCSD computer system were to be terminated." Concluded that the current process by which the Division was introducing micro computers would lead to reduced use of the UCSD VAX, but not entirely eliminate it. Further suggested that the expertise required to specify in-house alternatives to the UCSD VAX was not resident within the Division.

Management Review of Automated Data Processing in the Southwestern U.S.
Dated 2/86

An in-house team reviewed the "work performed, organization and staff performing the work, and the equipment and procedures employed in the production of of the southwestern ADP output." The objectives were to identify those activities which were appropriate to "contract-out" and to determine how the remaining activities could be accomplished more efficiently. The review team made 24 specific recommendations including: 1) the Regional Data Base Administrator (RDBA) was identified as the "key to success" and his function as a leader should be reinforced; he should develop an operations plan, petition for procurement authority and assure adherence to the plan; 2) the existing decentralized organization of ADP is advantageous to operational efficiency; however, the duties of the RDBA and his counterparts within the divisions and laboratories should be clarified and documented; 3) equipment standards should be specified and obsolete equipment phased out in a planned fashion; region-wide communication links should be upgraded and makeshift connections within the laboratories should be improved; and 4) the most efficient organization may be obtained by emphasizing the RDBA's role, contracting-out maintenance, engineering and data entry functions, upgrading computer programmer positions and converting them from temporary to permanent.

Appendix C: Functional requirements for La Jolla LAN

1. Access to the UCSD LAN's 28 ports and to the Molecular Computer's 32 ports provided to all terminals on the network.
2. Network nodes for connecting 32-bit computers to be used for data management and scientific computing.
3. Communications server providing access to time share facilities, outside networks and information services via modem. Remote access, through the communications server, should be provided to the network and all connected devices.
4. File server for storing network control software and providing shared access to data files and applications.
5. Control software with provisions for monitoring network activity, reallocating resources, establishing multilevel security protocols, and building menus for selecting network options.
6. Printer spooling for queuing several jobs routed to the same printer.
7. Electronic mail service including capability to cut-and-paste from foreground applications and send to designated addressees (or send entire files).
8. Personal computers connected to the network must have the ability to run single user applications (requiring substantial memory, eg: 512 k) without disconnecting from network.
9. The network topology and control software should conform to a broadly recognized and implemented standard. The IEEE 802.3 standard (CSMA/CD using bus topology), also known as Ethernet, is preferred.
10. Maintenance and service contract.

Appendix D: Major Data Base Systems

NAME	SIZE (Mb)	HOST COMPUTER
<u>Coastal Division</u>		
Survey System	20	UCSD VAX
CalCOFI	50	UCSD VAX
	<u>70</u>	
<u>Pelagic Division</u>		
Tuna/Billfishes Resources	100	UCSD VAX
No. Pac Albacore Fisheries	8	UCSD VAX
	<u>108</u>	
<u>Marine Mammal Division</u>		
Marine Mammal Project	250	UCSD VAX
<u>La Jolla Support Groups</u>		
Administrative Systems	2	La Jolla Molecular
FRS	2	La Jolla Molecular
	<u>4</u>	
<u>Honolulu</u>		
Fishery Research System	40	U. of Hawaii IBM 3081
WPACFIN	40	Honolulu Molecular
Lobster FMP System	20	IBM AT (MS-DOS computer)
Marine Mammals Info. System	10	U. of Hawaii IBM 3081
FRS	1	Honolulu Molecular
Fishery Statistics System	30	U. of Hawaii IBM 3081
	<u>141</u>	
<u>Tiburon</u>		
Recruitment/forecasting	0.2	IBM PC (MS-DOS computer)
Age Composition	10.5	IBM PC (MS-DOS computer)
Groundfish physiology	2	Televideo (CP/M computer)
Fish Communities	40	Tiburon Molecular
	<u>52.7</u>	
<u>PFEG</u>		
Albacore C/E	50	Charles River Data System
Surface Marine WX Obs	800	Cyber 855/860
Ocean flow/Transport	58	Cyber 855/860
Master Ocean. Obs. Data Set	1620	Cyber 855/860
Calif. Fish. and Biol. Data	980	Cyber 855/860
Coastal Sta SST/Air Temp/Sal.	2	Cyber 855/860
CDF&G Landings	2	Charles River Data System
	<u>3512</u>	
<u>Regional Offices</u>		
MBO Tracking System (MOATS)*	0.1	NOAA Time Share
Stall-Kennedy (SKIMS)*	0.1	NOAA Time Share
Market News Fish. Stats.	9	UCSD VAX, NOAA Time Share
Rec & and Comm Research Data	240	UCSD VAX, NWAFC
Burroughs		
PACFIN	660	UCSD VAX
Marine Mammal Strandings	0.1	NOAA Time Share
Tuna C/E	2	NOAA Time Share
Habitat Permits	2.5	NOAA Time Share
Tuna Fleet	0.1	NOAA Time Share
Finance*	0.5	NOAA Time Share
Financial Reporting System	0.3	NOAA Time Share
Pac Area Coop Enf Sys (PACES)	4	NOAA Time Share
Enf Mngt Info System (EMIS)*	2	NOAA Time Share
	<u>920.7</u>	

* denotes national data bases

